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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/086,892	03/04/2002	Kyo-Yeol Lee	030681-366	1940

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EXAMINER	
HOGANS, DAVID L	
ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 05/21/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/086,892

Applicant(s)

LEE, KYO-YEOL

Examiner

David L. Hogans

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 January 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-7, 15, 26-30, 34 and 35 is/are pending in the application.
- 4a) Of the above claim(s) 8-14, 16-25, 31-33 and 36-40 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7, 15, 26-30, 34 and 35 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 04 March 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 12-31-03
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

This Office Action is in response to the Amendment filed on January 12, 2004.

Status of Claims

Claims 1-7, 15, 26-30 and 34-35 are pending. Claims 8-14, 16-25, 31-33 and 36-40 are withdrawn.

Information Disclosure Statement

1. The information disclosure statement (IDS) submitted on December 31, 2003, is in compliance with the provisions of 37 CFR 1.97, and accordingly, has been considered by the examiner.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claims 1-7, 15, 26-30 and 34-35 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for a SiC or sapphire substrate, does not reasonably provide enablement for any type of substrate. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make the invention commensurate in scope with these claims. For instance, the Examiner is uncertain if the base substrate can be made of a material comprised by $C_6H_{12}O_6$, polyvinyl chloride, tantalum pentoxide or $LiAlO_2$. As the claim is presently drafted, "a base substrate" may comprise any known material

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(interpreting via MPEP § 2111), and this does not correspond with Applicant's scope of disclosure to the public.

4. Claims 1-7, 15, 26-30 and 34-35 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for doped and undoped GaN buffer layers, does not reasonably provide enablement for any type of buffer layer. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make the invention commensurate in scope with these claims. For instance, the Examiner is uncertain if the buffer layer can be made of a material comprised by InP, ZnO, LiGaO₂, or SiC.

5. Claims 1-7, 15, 26-30 and 34-35 are rejected under 35 U.S.C. 112, first paragraph, because the specification, while being enabling for a GaN semiconductor layer, does not reasonably provide enablement for any type of semiconductor layer. The specification does not enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make the invention commensurate in scope with these claims. For instance, the Examiner is uncertain if the semiconductor layer can be made of a material comprised by Si or Ge.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

7. Claims 1 and 3 are rejected under 35 U.S.C. 102(a) as being anticipated by JP2000-105321 to Toshiba.

In reference to Claims 1 and 3, Toshiba teaches:

- preparing a sapphire base substrate (10); (See Figure 1 and paragraphs 0016-0027)
- forming a first buffer layer (11) on the prepared base substrate; (See Figure 1 and paragraphs 0016-0027)
- forming a semiconductor layer (12) on the first buffer layer; (See Figure 1 and paragraphs 0016-0027) and
- after forming the semiconductor layer, removing the base substrate such that said semiconductor layer is a final substrate (See Figure 1 and paragraphs 0016-0027)

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

9. Claims 1 and 3 are rejected under 35 U.S.C. 102(b) as being anticipated by 5,905,275 to Nunoue et al.

In reference to Claims 1 and 3, Toshiba teaches:

- preparing a sapphire base substrate (11); (See Figure 1 and columns 4-10 lines 30-50)
- forming a first buffer layer (12) on the prepared base substrate; (See Figure 1 and columns 4-10 lines 30-50)
- forming a semiconductor layer (13) on the first buffer layer; (See Figure 1 and columns 4-10 lines 30-50) and
- after forming the semiconductor layer, removing the base substrate such that said semiconductor layer is a final substrate (See Figure 1 and columns 4-10 lines 30-50)

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claims 2, 4-6, 26, 27 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over 5,905,275 to Nunoue et al. in view of 5,290,393 to Nakamura.

Claim 2, 4, 26, 27 and 34

Incorporating all arguments of Claim 1 and noting that Nunoue et al. fails to explicitly teach forming a second buffer layer on the semiconductor layer before

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removing the base substrate, wherein the second buffer layer has the same structure as the first buffer layer and wherein the semiconductor layer is a silicon doped GaN layer.

However, Nakamura, in Figure 12 and columns 5-6 lines 60-02, column 7 lines 38-47 and columns 8-12 lines 05-27, teaches forming a second buffer layer formed on a silicon doped GaN semiconductor layer and wherein the first and second buffer layer have the same structure (i.e. – each buffer layer is a 0.02 micrometer GaN layer formed under similar process conditions).

It would have been obvious to one of ordinary skill in the art to modify Nunoue et al. by incorporating a first and second buffer layer comprised by the same structure, wherein the second buffer layer is formed on a silicon doped GaN semiconductor layer, as taught by Nakamura, to improve the crystallinity and carrier concentration/mobility of GaN layers. (See Figures 9 and 10 and column 5 lines 14-20 and column 9 lines 4-25 and column 10 lines 50-65)

Claims 5 and 6

Incorporating all arguments of Claims 1 and 2 and noting that Nunoue et al. fails to explicitly teach wherein the doping concentration profile of the second buffer layer is symmetrical or asymmetrical to the first buffer layer.

However, Nakamura, in column 8 lines 5-61 and column 10 lines 38-50, teaches wherein the first and second buffer layers have a symmetrical doping profile (i.e. – both undoped), and in column 8 lines 5-61 and column 10 lines 38-50 and column 11 lines 10-31, Nakamura teaches the first buffer layer being doped and the second buffer layer being undoped (i.e. – asymmetrical).

It would have been obvious to one of ordinary skill in the art to modify Nunoue et al. by incorporating wherein the doping concentration profile of the second buffer layer is symmetrical or asymmetrical to the first buffer layer, as taught by Nakamura, to improve the crystallinity of the epitaxial GaN semiconductor layer (i.e. – grown on undoped) and to also improve the conductivity characteristics of the n or p type GaN semiconductor epitaxial layers grown on the doped buffer layers. (See column 5 lines 14-20 and column 12 lines 18-27)

Furthermore, the Examiner notes that the specification contains no disclosure of either the critical nature of the claimed method or any unexpected results arising therefrom (i.e. – what unexpected results arise from symmetry, or lack thereof, of buffer layers when forming semiconductor layers). Where patentability is said to be based upon particular chosen methods or upon other variables recited in a claim, the Applicant must show that the chosen methods are critical. *In re Woodruff*, 919 F.2d 1575, 1578 (Fed. Cir. 1990).

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12. Claims 7, 15, 28-30 and 35 are rejected under 35 U.S.C. 103(a) as being unpatentable over 5,905,275 to Nunoue et al. in view of 5,290,393 to Nakamura further in view of 5,847,409 to Nakayama.

Claims 7, 15, and 28-30

Incorporating all arguments of Claims 1 and 2 and noting that Nunoue et al. and Nakamura fail to explicitly teach wherein the first and/or second buffer layer is formed of multiple semiconductor layers having different doping concentrations.

However, Nakayama, in Figures 2-5 and columns 3-9 lines 05-35, teaches wherein a buffer layer (102) can be formed of multiple semiconductor layers (1a and 1b) having different doping concentrations.

It would have been obvious to one of ordinary skill in the art to modify Nunoue et al. and Nakamura by incorporating wherein a buffer layer can be formed of multiple semiconductor layers having different doping concentrations, as taught by Nakayama, to prevent the formation of dislocations and lattice defects in a active semiconductor layer.

Claim 35

Incorporating all arguments of Claims 1, 2 and 15 and noting that Nunoue et al., in column 5 lines 01-09, teaches wherein the semiconductor layer is a Group III-V compound having conductivity.

Response to Arguments

13. Applicant's arguments with respect to claims 1-7, 15, 26-30 and 34-35 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US 6,475,882 to Sakai et al. teaches forming a GaN semiconductor layer over a buffer layer with another buffer layer formed over the GaN semiconductor layer.

15. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David L. Hogans whose telephone number is (571) 272-1691. The examiner can normally be reached on M-F (7:30-4:30).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr. can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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